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Search for a light Z' at LHC in a neutrinophilic $U(1)$ model

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We consider a neutrinophilic $U(1)$ extension of the standard model (SM) which couples only to SM isosinglet neutral fermions, charged under the new group. The neutral fermions couple to the SM matter fields through Yukawa interactions. The neutrinos in the model get their masses from a standard inverse-seesaw mechanism while an added scalar sector is responsible for the breaking of the gauged $U(1)$ leading to a light neutral gauge boson (Z') which has minimal interaction with the SM sector. We study the phenomenology of having such a light Z' in the context of neutrinophilic interactions as well as the role of allowing kinetic mixing between the new $U(1)$ group with the SM hypercharge group. We show that current experimental searches allow for a very light Z' if it does not couple to SM fields directly and highlight the search strategies at the LHC. We observe that multi-lepton final states in the form of $(4l + E/\gamma)$ and $(3l + 2j + E/\gamma)$ could be crucial in discovering such a neutrinophilic gauge boson lying in a mass range of 200–500 GeV.

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